

AFOSR-TR-91-0684

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank) 2. REPORT DATE 3. REPORT TYPE AND DATES COVERED
Final 01 Aug 96 to 31 Jul 97

4. TITLE AND SUBTITLE
(DURIP-96) MOMENTUM RESOLVED ESDIAD - A NEW WAY TO STUDY
SURFACE DYNAMICS WITHOUT A LASER

5. FUNDING NUMBERS

61103D
3484/US

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REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

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110 DUNCAN AVE ROOMB115
BOLLING AFB DC 20332-8050

10. SPONSORING/MONITORING
AGENCY REPORT NUMBER

F49620-96-1-0422

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

APPROVAL FOR PUBLIC RELEASED: DISTRIBUTIONS UNLIMITED

19971204 173

13. ABSTRACT (Maximum 200 words)

An existing older Varian UHV system has been modified so that a new momentum-selective ESDIAD system included. All necessary electronic parts and computers have been purchased and the majority of it has been tested and used in a preliminary version of the TOF-ESDIAD system. First results are already published

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DTIC QUALITY INSPECTED

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION
OF REPORT

18. SECURITY CLASSIFICATION
OF THIS PAGE

19. SECURITY CLASSIFICATION
OF ABSTRACT

20. LIMITATION OF ABSTRACT

Final Report
AFOSR – DURIP Grant F49620-96-1-0422
November 12, 1997

"Momentum Resolved ESDIAD – A New Way to Study Surface Dynamics Without a Laser"

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An existing older Varian UHV system has been modified so that the new momentum-selective ESDIAD system can be included. All necessary electronic parts and computers have been purchased and the majority of it has been tested and used in a preliminary version of the TOF-ESDIAD system. First results are already published (see references [1-3]).

- 1) The following extensive changes and necessary improvements of the UHV system have been made by installing and testing the following items (compare the attached equipment list): Custom built UHV chamber (item 14); New vacuum gauges, valves and other UHV hardware (items 15,...,18,22,24).
- 2) **Closed cycle Helium cryogenic system** (item 12): In order to perform dynamic measurements at the zero point energy level (compare attached publication [3]) a new design of the manipulator including the cooling and heating system was necessary. The constructions are completed and under test in the new chamber.
- 3) **Pulsed electron gun system** (items 13 and 8): The electron gun system has been built in the new chamber and aligned (using the Precision Off Axis Port Aligner, item 15). It has been tested using a self-made phosphor screen. By employing the Avtech pulse generator (item 8) electron pulses of widths down to 500 ps could be obtained. For the pulse widths measurements the multi-scaler system (item 2), the oscilloscope (item 3) and the computer (items 10 and 11) have been employed.

4) Specially designed detector system (item 9): A newly designed TDC (Time to Digital Converter) has been build and tested at the University's electronic shop. The ultra fast position detector system including the multi-parameter system (item 9) is under testing at the company Quantar Technology. The delivery of the system has been delayed due to problems with the Resistive Anode. The delivery is expected at the end of November.

5) Electronic equipment, pulsing and timing (items 1, 2, 3, 8, 10, 19, 20, 21, 23, 25): The full capability of the new system allowing the highly time and angle resolved TOF-measurements will be possible only after including the new detector in the system. Nevertheless preliminary TOF ESDIAD measurements have been successfully performed by applying the new electronic equipment for pulsing and timing to a modified older detector system (see references [1-3]).

References:

1. J. T. Yates, Jr., J. Ahner and D. Mocuta, "Tracking the Motion of Chemisorbed Molecules on Their Adsorption Sites," submitted to Proceedings of National Academy of Sciences.
2. J. Braun, J. Weckesser, J. Ahner, D. Mocuta, J. T. Yates, Jr. and Ch. Wöll, "The Frustrated Translational Mode of CO on Cu(110): Azimuthal Anisotropy Studies by Helium Atom Scattering- A Comparison with Time of Flight ESDIAD* Measurements," submitted to J. Chem. Phys.
3. J. Ahner, D. Mocuta, R. D. Ramsier and J. T. Yates, Jr., "Measurement of Anisotropy in the Lateral Momentum of a Vibrating Adsorbed Molecule – CO/Cu(110)," Phys. Rev. Lett. 79, 1889 (1997).

| Item# | Manufacturer | Catalog# | Name | Acquisition Price | Comments | Changes to the equipment list |
|-------|---|---|---|--|--|---|
| 1 | Stanford Research Systems 1290 D Reamwood Ave. Sunnyvale, CA 94089 | DG535 -104C -105 | Digital Delay/ Pulse Generator + -Option 4C Bias Tee -Option 5 Dual Rack Mount | \$3,750 | Catalog Price: \$4,600 | |
| 2 | EG&G Instruments, Inc., EG&G Ortec Division 100 Midland Road, Oak Ridge, TN, 37830 | Model 9306 Model 9307 Model 9308 Model PCBCBC1 Model 566 4001A/4002D | 1 Ghz Preamplifier Pico-Timing Discriminator Picosecond Time Analyzer Computer Interface with Cable Time to Amplitude Converter NIM bin & 160 W power supply | \$541 \$1,473 \$8,620 \$265 \$1,100 \$1,999 | Catalog Price: \$605 \$1650 Discount Discount Catalog Price: \$1,650 | Not Included Not Included Not Included |
| 3 | Tektronix, Inc. 700 Professional Drive, Gaithersburg, MD 20819 | TDS744A | Digital Oscilloscope, 500 Mhz with Cart | \$12,200 | Test Instrument | Upgrade from TDS540A in the equipment list |
| 8 | Aytech Electrosystems Ltd., P.O. Box 265, Ogdensburg, NY 13669-265 | 9-AVR-E2-P5 AVX-1 | Pulse Generator + EA, EW, OS Options and Inverting Transformer | \$4,227 | Discount | Replaces HP Programmable Pulse Generator 8114A; \$9,450 |
| 9 | Quantar Technology, Inc, 3004 Mission Street, Santa Cruz, CA | 3392A | MCP/ RAE Sensor, 75 mm Diam. Active Area, 2MCP's, 1/100 Spatial Resolution | \$14,950 | Not Received | |

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| | | | |
| 3392/001 | Option 001/SE: Add Electrically Isolated Front Ring to Std. 3392A | \$350 | |
| 3392/SH | Option SH, Install 10K RAE Compatible w/Model 2502 in place of std | \$400 | |
| 3392/SM | Option SM, Install Hot Type MCP's instead of std | \$1600 | |
| 2502A | Model 2502A position Analyzer, High Speed | \$14,750 | |
| 2502/X98 | Add option X98 Spec Modif. To 2502 for TDC Input to FIFO | \$600 | |
| SPECMISC | Special Item: Modify 2502 data cables | \$450 | |
| MPABBS | MPA Base System w/ Small Busbox w/3 ADC Interfaces, MPA-PC 1 MB board, factory config. | \$5,400 | |
| MPA/2MB | Increase MPA board Memory to 2 MB | \$1,990 | |
| MPAWIN | MPA Windows Based Software | \$5,650 | |

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|----|--|---|----------|----------------------------|----------------------|
| | MPA/REPLAY | Replay/Parser Software Option for MPAWIN | \$950 | | |
| | 7070 | Fast 100 MHz ADC, 8192 Channel, Nim Module | \$1,675 | | |
| | FRT | Freight Charge | \$177 | | |
| 10 | NSA Hitachi, 100 Lowder Brook Drive, Westwood, MA 01879 | CM611U Hitachi/NSA Superscan Elite 611 Color Monitor/17" | \$700 | Catalog Price: \$799 | Changed Company |
| 11 | Gateway2000, 610 Gateway Drive, P.O. Box 2000, North Sioux City, South Dakota 57049-2000 | Gateway G6-200 Computer | \$4,521 | | Changed Company |
| 12 | Advanced Research Systems, 1942 Riverbend Rd., Allentown, PA 18103 | Closed Cycle Dispex System + Programmable Temperature Controller + Model MB2002 Precision XYZ Manipulator + Model DPRF600 Differentially Pumped Rotary Platform | \$30,080 | Discount | Included in Budget A |
| 13 | Kimball Physics Inc., 311 Kimball Hill Road, Wilton, NH 03086-9742 | ELG-21EGPS-2 Low Energy Electron Gun System | \$15,440 | Catalog Price: \$16,120 | |

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|----|--|---|------------|------------------------|-------------------------|
| 14 | Kurt Lesker Company, 1515 Worthington Ave. Clairton, PA, 15025 | UHV Hardware | \$6,416.10 | 10% discount | Changed Manufacturer |
| 15 | MDC Vacuum Products Corp., 23842 Cabot Blvd., Hayward, CA 94545 | Custom Built UHV Chamber | \$8,500 | | Changed Manufacturer |
| 16 | Pittsburgh Valve and Fitting Company, 49 Meade Ave., P.O. Box 4155, Bellevue, Pittsburgh, PA 15202 | PAT-10 Precision Off Axis Port Aligner | \$650 | | |
| 17 | VAT, 500 West Cummings Park, Woburn, MA 01801 | Precision Off Axis Port Aligner | \$750 | | |
| 18 | Varian Vacuum Products, 121 Hartwell Ave., Lexington MA 02173 | Various Pre-vacuum Hardware | \$4598 | University Discount | |
| 19 | National Instruments, 6504 Bridge Point Parkway, Austin, TX 78730-5039 | Multi Gauge Controller, Various Transducers + PC Controller Boards and Cables | \$4,428.50 | Discount | Included in Budget A |
| | | PCI-GPIB and NI- 488 2M for Windows 95 | \$495 | | |
| | | Type X2 double Shielded GPIB Cable, 2m, 2pc. | \$170 | | |

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|----|---|-----------|---|---------|----------|---|
| | | 763061-04 | Type X2 double Shielded GPIB Cable, 8m | \$105 | | |
| 20 | Hewlett Packard Co. (2609), 111 Zeta Drive, Pittsburgh, PA, 15238 | HP6644A | Single-output system and power supply: 200W | \$1,912 | Discount | Replaces Tectronix Power Supply |
| | | Opt 908 | Rack-mount Kit | \$29.60 | | |
| 21 | Dell Computer Corporation, One Dell Way, Round Rock, Texas 78682 | | Computer + Monitor | \$2,501 | | Not Included |
| 22 | Granville Phillips Company, 5675 Arapahoe Avenue, Boulder, Colorado, 80303-1398 | 203036-04 | Variable Leak Valve / Cajon Connections/ Style 04 | \$1,150 | | Replaces Balzers/ Pfeiffer Dosing valve in Budget A |
| 23 | Wavetek Corp., 9045 Balboa Ave., San Diego, CA 92123-1509 | Model 81 | 50 Mhz Pulse / Function generator | \$4,080 | Discount | Not Included |
| 24 | Matheson Gas Products, 166 Keystone Drive Montgomeryville PA 18936 | 2101182-0 | Argon, Research purity, 7A cyl. | \$228 | | |
| | | 3813-580 | Regulator, dual stage high purity stainless steel | \$729 | | |
| 25 | D&K Electronics, 1224 East Carson Street, Pittsburgh, PA 15203 | 8x36 70ns | 16 MB SIMM Memory Module, 2pc. | \$338 | | Not Included |